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Dutta et al.

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(54) **HIGH SENSITIVITY SENSOR DEVICE AND MANUFACTURING THEREOF**

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(58) **Field of Classification Search**

CPC **G01N 21/00**
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,785,432 B2 * 8/2004 Letant **G01N 21/774**
250/227.11
2008/0095663 A1 * 4/2008 Dutta **B82Y 20/00**
422/400

OTHER PUBLICATIONS

Dutta et al., "Novel Optical Nano-sensor for Biomolecule and Chemical Agents Detection", May 2005, Proc. SPIE, vol. 5733, pp. 142-151.*

* cited by examiner

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(57) **ABSTRACT**

A sensing device able to do concurrent real time detection of different kinds of chemical, biomolecule agents, or biological cells and their respective concentrations using optical principles. The sensing system can be produced at a low cost (below \$1.00) and in a small size (~1 cm³). The novel sensing system may be of great value to many industries, for example, medical, forensics, and military. The fundamental principles of this novel invention may be implemented in many variations and combinations of techniques.

20 Claims, 9 Drawing Sheets

